ECE 214 — Final Exam

Estimated time for completion: $\leq$ 2.0 hour
7 May 2019

Rules of the Exam

Rule 1: The examination period begins at 10:30 am on Tuesday, 7 May 2019 and ends at 12:20 pm on Tuesday, 7 May 2019.

Rule 2: The exam is worth 15 points.

Rule 3: The exam is closed book and closed notes. You may use your ECE 214 Laboratory Notebook, a ruler, and a calculator.

Rule 4: To receive credit for an answer, include the units along with the numerical answer.

Rule 5: Show all work - answers without supporting work will not receive credit. Please circle your final answer or write the answer on the line provided.

Rule 6: Do not leave the room until you have completed the exam.

Rule 7: There are five problems; answer any three. Each problems is worth 6 points. The maximum score is 18 out of 15. If you choose questions 1, 2, and 3, and score higher than your Exam #2 score, the final exam score will replace your Exam #2 score; if you choose questions 1, 4, and 5, and score higher than your Exam #1 score, the final exam score will replace your Exam #1 score.

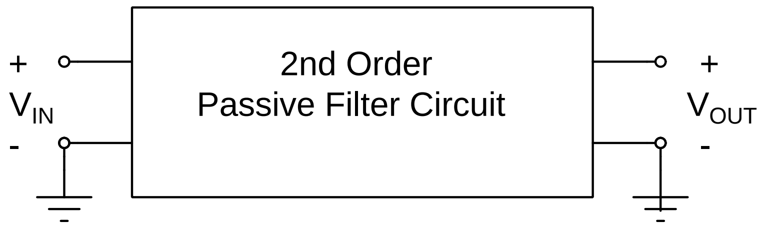
Rule 8: Circle the numbers corresponding to the problems you want graded:

1 2 3 4 5

____

Name

Problem 1: Consider the 2nd order ideal passive filter circuit shown below:



1. V_{IN} is a square wave with a 50% duty cycle and a frequency of 25 kHz. V_{OUT} is a sinusoidal waveform with a single frequency of 100 kHz. What type of filter could be used to generate V_{OUT} (low pass, band pass, band reject, high pass, or no filter can produce this output)?

2. V_{IN} is a square wave with a 75% duty cycle and a frequency of 20 kHz. V_{OUT} is a sinusoidal waveform with a single frequency of 50 kHz? What type of filter could be used to generate V_{OUT} (low pass, band pass, band reject, high pass, or no filter can produce this output)?

3. V_{IN} is a square wave with a 50% duty cycle and a frequency of 15 kHz. The filter is a high pass filter with a cutoff frequency of 9 kHz. What is the relative amplitude of the 5th harmonic to the fundamental frequency at the output of the filter?

   ____

4. V_{IN} is a square wave with a 50% duty cycle and a frequency of 9 kHz. The filter is a high pass filter with a cutoff frequency of 9 kHz. What is the relative amplitude of the 5th harmonic to the fundamental at the output of the filter?

   ____

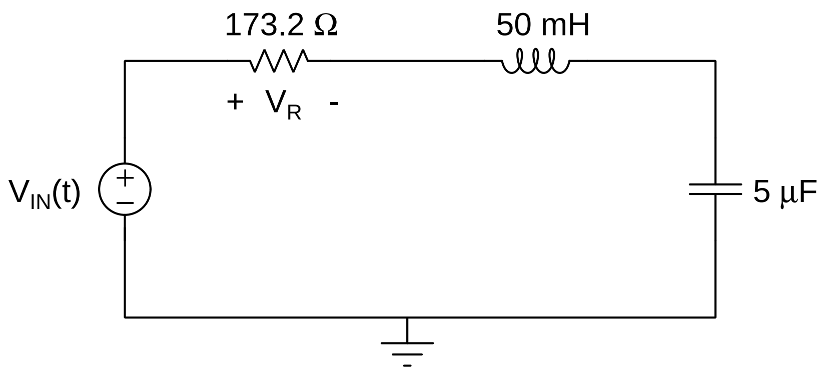
5. V_{IN} is a square wave with a 50% duty cycle and a frequency of 3 kHz. The filter is a high pass filter with a cutoff frequency of 9 kHz. What is the relative amplitude of the 5th harmonic to the fundamental at the output of the filter?

   ____

6. V_{IN} is a square wave with a 50% duty cycle and a frequency of 1 kHz. The filter is a high pass filter with a cutoff frequency of 9 kHz. What is the relative amplitude of the 5th harmonic to the fundamental at the output of the filter?

   ____

Problem 2: Consider the series RLC circuit shown below. Assume all circuit elements are ideal.

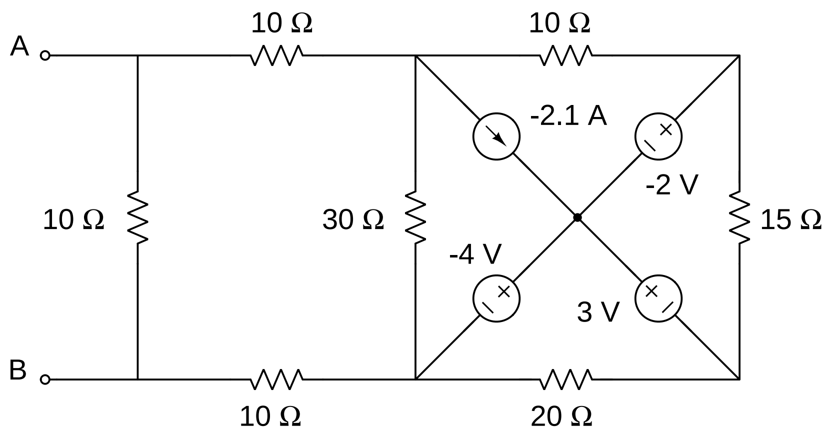


(a) $V_{IN}(t) = 5\cos(2000t - 40°)$. What is $V_R(t)$ at $t = 0.4$ ms? ____________________

(b) $V_{IN}(t)$ is a 5 V step function applied at $t = 0$. Assume no energy is stored in the circuit at $t = 0$. What is $V_R(t)$ at $t = 0.4$ ms?

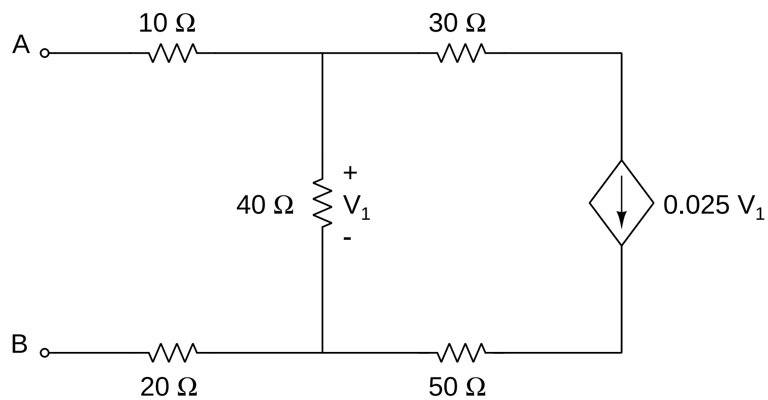
____

Problem 3(a): Consider the circuit shown below.



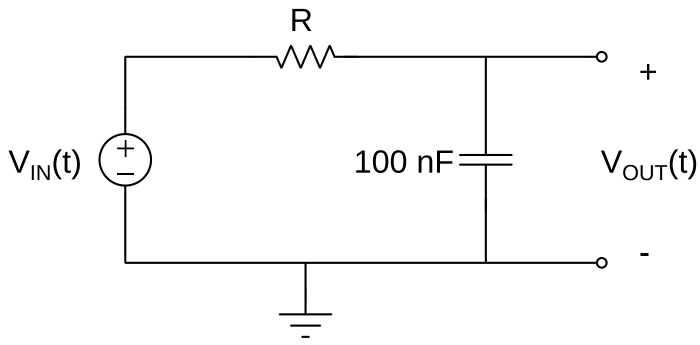
(a) Draw the Thévenin equivalent circuit with respect to terminals **A** and **B**.

Problem 3(b): Consider the circuit shown below.



(b) Draw the Thévenin equivalent circuit with respect to terminals **A** and **B**.

Problem 4: Consider the RC circuit shown below:



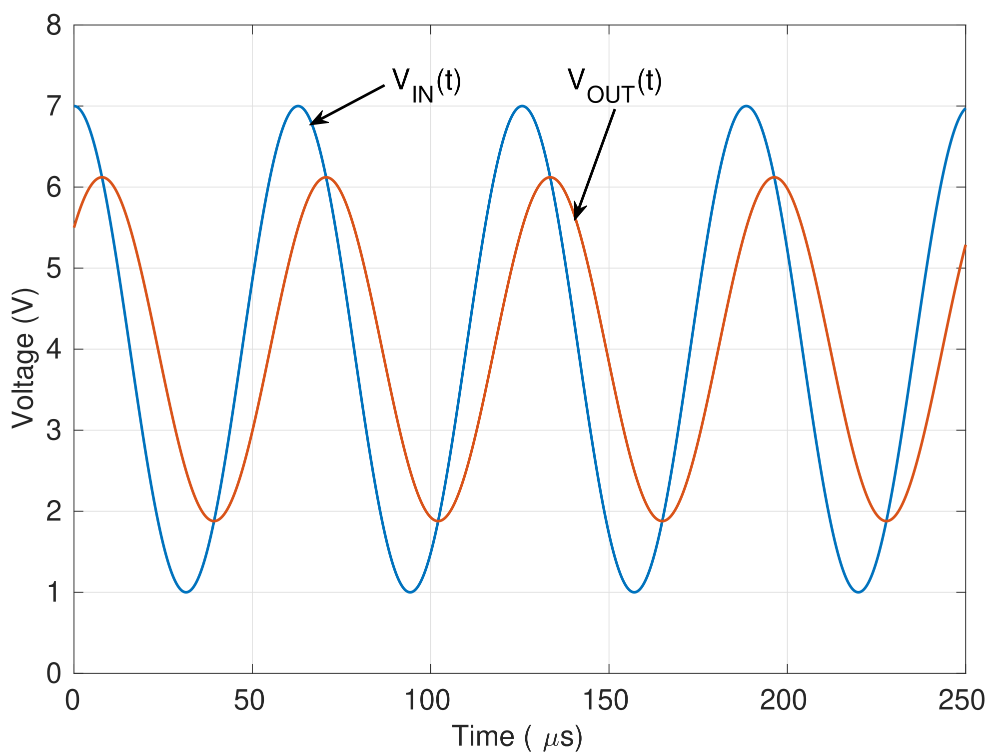
The input signal V_{IN} and output signal V_{OUT} are given by:

$$V_{IN}(t) = A\cos(\omega t) + V_{DC}$$

and

$$V_{OUT}(t) = B\cos(\omega t + \phi) + V_{DC}$$

and are shown below:



1. What is B? ______________________

2. What is ω? ______________________

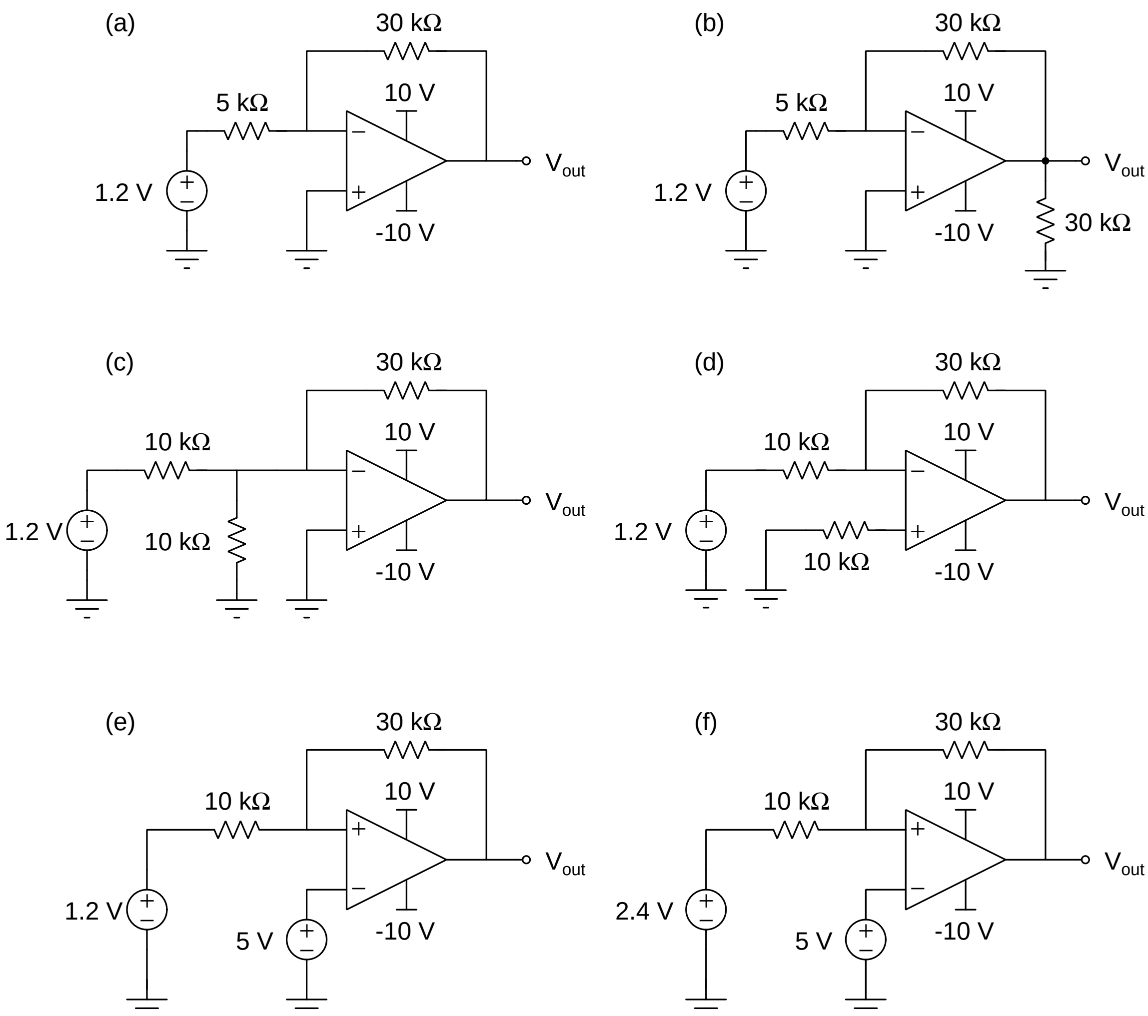
3. What is ϕ? ______________________

4. What is V_{DC}? ______________________

5. What is R? ______________________

6. What is the average energy stored in the capacitor? ______________________

Problem 5: For the OpAmp circuits below, calculate the output voltage, V_{out}. The OpAmps are ideal.



OpAmp	V_{out}	OpAmp	V_{out}
(a)		(b)	
(c)		(d)	
(e)		(f)	

Blank page for calculations. Name: ____________________

Blank page for calculations. Name: ____________________

Blank page for calculations. Name: ______________________